Effect of large herbivore exclusion on understorey biomass in three plant communities on Cobourg Peninsula

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Abstract

Gurig National Park on Cobourg Peninsula supports the only Australian feral herd of Banteng *Bos javanicus*. Previous correlative surveys suggested that the feral Banteng have a minor impact on the native vegetation in the Park. Three year experimental exclusion of large herbivores at one site on the largely treeless coastal plains suggested that grazing had no significant effect on the herb biomass compared to an adjacent unfenced plot. However herb biomass in fenced eucalypt savanna and savanna-rainforest ecotone communities was significantly greater than that in unfenced plots. These results indicate that eucalypt savanna and rainforest ecotone communities are an important food source for large herbivores, and that the previously observed high density of Banteng signs on the coastal plains may be unrelated to total food supply.

Introduction

Banteng *Bos javanicus*, a south-east Asian bovine, became feral on the Cobourg Peninsula following the failure of a British settlement in the late 1840s. Unlike buffalo *Bubalis bubalus*, the Banteng populations have grown slowly with an estimated current population of about 3,500 beasts on Cobourg Peninsula, although they occur at density greater than that reported from native habitats (Freeland 1990). For unknown reasons the Banteng have never spread far from their point of introduction (Bowman 1993a).

A previous survey of twelve habitats on Cobourg Peninsula revealed that signs and impacts of Banteng are focused on treeless coastal plains and monsoon rainforests (Bowman & Panton 1991). Banteng are thought to graze preferentially the treeless plains at night and retreat to the cover of the rainforest during the day (Calaby & Keith 1974). Bowman & Panton (1991) found that Banteng signs were least conspicuous in *Eucalyptus* savanna which comprises over 95% of the vegetation coverage on the Peninsula.

Bowman & Panton (1991) noted that their interpretations were based on correlative evidence and suggested that firmer conclusions would require experimental

studies. Here I report the results of two field experiments. I describe the effect of exclusion of large herbivore on: (1) herb biomass on treeless coastal plains; and (2) herb biomass across the boundary between monsoon rainforest and eucalypt savanna. Spotlight surveys and field traverses demonstrated that the primary large herbivores at Cobourg Peninsula were Banteng, the remainder being macropods.

PLATE 1 *Dead Banteng in late dry season, Cobourg Peninsula* (D Bowman)

Methods

Cover estimates were made at the start of the experiments because they are non-destructive, albeit less accurate than direct measurement of biomass. At the conclusion of the experiment biomass was harvested from the plots for which cover estimates had been made three years earlier. No attempt was made to determine floristic changes because many species were unrecognisable at the time of sampling.

Large herbivore exclusion on coastal plains

The vegetation on the coastal plains was dominated by the sedges *Bulbostylis barbarta* and *Fimbristylis* sp., the grasses *Sorghum plumosum* and *Perotis rara* and the forbs *Ptilotus conicus* and *Borreria* sp. (see Bowman *et al.* 1990 for a description of

this community). In an area of homogeneous vegetation on the coastal plains, near the airstrip on Cobourg Peninsula, two 50 m x 50 m plots were established spaced 50 m apart from each other. One plot was fenced with pigmesh wire to exclude large herbivores. Fire breaks were graded around the perimeter of the plots.

In June 1988 the percentage cover of vegetation was estimated for 25 0.5m x 1.0m quadrats, using a modified cover abundance scale. The quadrats were systematically set out 5m apart in a permanently marked 20m x 20m grid located in the centre of each plot. In May 1991 the herb layer at each quadrat was harvested to determine total herb biomass following oven drying of the samples for 24 hours at 60°C.

Herbivore exclusion on a fire protected ***Eucalyptus*** *savanna boundary*

In 1988 two parallel 150m transects, spaced 100m apart, were established at right angles to a monsoon rainforest boundary. The plant communities along these transects comprised *Eucalyptus* savanna, rainforest ecotone and dry monsoon rainforest as defined by Bowman (1993b). The herb layer in the *Eucalyptus* savanna and rainforest ecotone was dominated by a variety of perennial grasses including *Sorghum plumosum*, *Heteropogon contortus*, *Chrysopogon latifolius*, and *Sehima nervosa*. Numbered steel pickets were placed every 5m along both transects. A rectangular pigmesh fence was built around one transect. In June 1988 the total percentage cover of herbaceous vegetation was assessed in two contiguous 1m x 4m quadrats located at each 5m mark along the transects. In June 1991 the herb layer from three 0.5m x 1.0m quadrats was harvested at each 5 m mark on each transect to determine the herb biomass following oven drying at 600 C for 24 hours.

Data analysis

Non-parametric Wilcoxon tests were used to test the following null hypotheses: (1) that there were no differences between cover of herbs on the two plots on the coastal plains at the time of establishing the fencing experiment; (2) that three years of large herbivore exclusion caused no difference in the herb biomass on these plots; (3) that there was no difference in the cover of herbs in (savanna and ecotone communities) on the rainforest boundary at the time of establishing the fencing experiment. No comparison was made for the rainforest community as there are no herbs on the forest floor; and (4) that three years of herbivore exclusion caused no difference in the herb biomass in the savanna and ecotone.

Results

There was no significant difference ($P > 0.05$) between the fenced and unfenced plots in the mean herb cover at the time of establishing the experiment (Table 1).

After three years the mean herb biomass was not significantly different ($P > 0.05$) between the unfenced and fenced plots (Table 1). There was no significant difference ($P > 0.05$) between fenced and unfenced plots in the mean total cover of herbs of either the eucalypt savanna or rainforest ecotone at the time of establishing the experiment (Table 2). Mean total biomass was significantly greater on the fenced transect than the unfenced transect after three years of herbivore exclusion (Table 2).

Discussion

This study shows that large herbivores have a significant impact on herb biomass in eucalypt savanna and rainforest ecotone. One positive consequence of this biomass removal may be a reduction of fire intensities on the rainforest boundary.

TABLE 1 *Mean (and standard error) of percentage herb cover in fenced and unfenced plots on treeless coastal plains in 1988; and total herb biomass in 1991. Significance of differences between plots for each year of measurement are determined by Wilcoxon tests.*

	Fenced	Unfenced	Significance
Herb cover (%)	34 (1.9)	36 (1.5)	$P > 0.05$
Herb biomass (gm^{-2})	100 (9.3)	80 (7.7)	$P > 0.05$
n	25	25	

The greater occurrence of Banteng signs on the coastal plains compared to the eucalypt savanna (Bowman & Panton 1991) may be unrelated to total food supply given that herbivore exclusion had no significant effect on herb biomass on the plains. An alternative explanation for the conspicuous sign of Banteng on the coastal plains, yet the apparent minimal impact of herbivory, is that grazing has a stimulatory effect on herb growth on the plains, or stimulates the growth of unpalatable species. Data on changes to species composition are required to explore these ideas.

TABLE 2 *Mean (and standard error) of percentage herb cover in fenced and unfenced eucalypt savanna and ecotone on a monsoon rainforest boundary in 1988 (upper), and herb biomass in 1991 (lower). Significance of differences between fenced and unfenced communities are determined by Wilcoxon tests.*

	Savanna			*Ecotone*		
	Fenced	Unfenced	Sig	Fenced	Unfenced	Sig
Herb cover (%)						
Mean	36	26	$P>0.05$	13	9	$P> 0.05$
SE	5.1	4.4		2.2	0.9	
n	34	24		12	26	
Biomass (gm^{-2})						
Mean	132.9	76.8	$P< 0.001$	46.4	2.7	$P< 0.01$
SE	11.7	23.2		24.8	1.9	
n	51	36		18	39	

Assuming that the results demonstrate a large off-take (56 gm^{-2}) of *Eucalyptus* savanna by Banteng then the biogeographic puzzle of why Banteng have not exploited more of the Top End's savannas is further underlined (Bowman 1993a). One possible reason for the geographic restriction of Banteng is that they must supplement their diet of savanna herbs with minerals acquired from seawater.

The results presented here caution against extrapolation of herbivore impacts from simple correlative studies of animal sign such as those of Bowman & Panton (1991). More detailed studies are required to determine what the effect of Banteng herbivory is on the ecology of Gurig National Park. These studies should ensure that they overcome the deficiencies of this study such as the lack of replication of exclosures and lack of data on the changes to different herb species biomass.

Acknowledgments

The Gurig Board is thanked for permission to conduct this research. Craig Martin, Leonie McDonough, Bill Panton and Bruce Wilson are thanked for their field assistance. Funding from the Endangered Species Unit, ANPWS and the National Rainforest Conservation Programme supported some aspects of this research and is gratefully acknowledged.

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PLATE 2 *Coastal calcareous plains typical of study site* (D. Bowman)